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09/869140

June 26, 2001

BOX PCT

Commissioner for Patents
Washington, D.C. 20231

PCT/FR99/03268
-filed December 23, 1999

Re: Application of Guillaume CALOT, Cedric LAPAILLE
METHOD FOR CONTROLLING A TRANSMITTER POWER BY MEANS OF RECEIVED SIGNALS
Assignee: ALCATEL
Our Ref: Q64916

Dear Sir:

The following documents and fees are submitted herewith in connection with the above application for the purpose of entering the National stage under 35 U.S.C. § 371 and in accordance with Chapter II of the Patent Cooperation Treaty:

☑ an executed Declaration and Power of Attorney.

☑ an English translation of the International Application.

☑ 3 sheet(s) of drawings.

☐ an English translation of Article 19 claim amendments.

☐ an English translation of Article 34 amendments (annexes to the IPER).

☑ an executed Assignment and PTO 1595 form.

☑ a Form PTO-1449 listing the ISR references, and a complete copy of each reference.

☑ a Preliminary Amendment

It is assumed that copies of the International Application, the International Search Report, the International Preliminary Examination Report, and any Articles 19 and 34 amendments as required by § 371(c) will be supplied directly by the International Bureau, but if further copies are needed, the undersigned can easily provide them upon request.

Assignment for published patent application is: **ALCATEL**.

09/869140

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PLEASE SEE THE ATTACHED PRELIMINARY AMENDMENT BEFORE CALCULATING THE FEE

The Government filing fee is calculated as follows:

Total claims	13	-	20	=		x	$18.00	=	$.00
Independent claims	1	-	3	=		x	$80.00	=	$.00
Base Fee									$860.00
TOTAL FILING FEE									$860.00
Recordation of Assignment									$ 40.00
TOTAL FEE									$900.00

Checks for the statutory filing fee of $860.00 and Assignment recordation fee of $40.00 are attached. You are also directed and authorized to charge or credit any difference or overpayment to Deposit Account No. 19-4880. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16, 1.17 and 1.492 which may be required during the entire pendency of the application to Deposit Account No. 19-4880. A duplicate copy of this transmittal letter is attached.

Priority is claimed from December 30, 1998 based on French Application No. 9816623.

Respectfully submitted,

David J. Cushing
Registration No. 28,703

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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Guillaume CALOT, et al.

Attorney Docket Q64916

Appln. No.: Not Assigned

Group Art Unit: Not Assigned

Confirmation No.: Not Assigned

Examiner: Not Assigned

Filed: June 26, 2001

For: METHOD FOR CONTROLLING A TRANSMITTER POWER BY MEANS OF RECEIVED SIGNALS

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Please add the following section headings:

Page 1, after the title, insert the heading:

Background of the Invention

Page 3, before the second full paragraph beginning with "The invention relates" insert the heading:

Summary of the Invention

Page 8, before the first paragraph, insert the heading:

Brief Description of the Drawings

before the seventh paragraph beginning with "The example" insert the heading:

Detailed Description of the Invention

09869140.062601

<u>IN THE CLAIMS</u>:

Please cancel claims 1-13 without prejudice or disclaimer.

Please add the following new claims 14-26.

14. A telecommunication method, wherein:

- a transmitter (40) transmits information to a receiver (44) with a power that varies according to a set point supplied by the receiver,
- this set point is established from a comparison between a characteristic ($\hat{\gamma}$) of the received signal and a reference characteristic (γ_{ref}),
- the purpose of the set point is to maintain the power of the transmitter at such a level that the characteristic of the received signal is constantly equal to or similar to the reference characteristic,
- since a delay occurs in the transmission of signals between the transmitter and the receiver, the set point is generated in the receiver whenever information is received, from, on the one hand, said comparison between the characteristic of the received signal and the reference characteristic and, on the other hand, from a signal representing the transmission power of the received signal wherein the set point is generated from the set points previously generated and transmitted to the transmitter but which the latter could not registered owing to the transmission delays.

15. A method according to claim 1, wherein, since the characteristic is a smoothed signal to noise ratio, in the receiver, the instantaneous signal to noise ratio ($\tilde{\gamma}$) of the received

signal is determined, it is divided by a signal (T_x) representing the transmission power of the received signal, this ratio is smoothed and the smoothed ratio is multiplied by the signal (T_x) representing the transmission power of the received signal, the result ($\hat{\gamma}$) of this multiplication being the characteristic which is compared to the reference.

16. A method according to claim 2, wherein the update, at time t, in the receiver, of the signal (T_x) representing the transmission power of the received signal is made after a time t' has elapsed following transmission of a set point from the receiver to the transmitter, this time t' being equal to the sum of the transmission delay t_p from the receiver to the transmitter, the processing time t_e or acknowledgement of the set point in the transmitter and the transmission delay time t_p from the transmitter to the receiver, and in that this update involves multiplying the previously stored power by the set point issued at time t.

17. A method according to claim 3, wherein the set point C(t) is generated from the following formula:

$$C(t) = \frac{\gamma_{ref}}{\hat{\gamma}(t)} \frac{T_x(t)}{T_x(t+t')}$$

wherein γ_{ref} is the value of the reference characteristic, $\hat{\gamma}(t)$ the value of the characteristic measured at time t in the receiver, $T_x(t)$ and $T_x(t+t')$ are the signals representing the transmission power of the signal received at times t and t+t' respectively.

18. A method according to claim 3, wherein the set point C(t) is generated from the following formula:

$$C(t) = \frac{\gamma_{ref}}{\hat{\gamma}(t)} \quad \frac{1}{\Pi C}$$

in which γ_{ref} is the reference characteristic value, $\hat{\gamma}(t)$ the value of the characteristic measured at time t in the receiver and ΠC the set point or product of the set points previously issued but not yet registered by the transmitter.

19. A method according to claim 1 , wherein the set point transmitted by the receiver to the transmitter is transmitted simultaneously with information or signalling data.

20. A method according to claim 6, wherein the data transmitted from the receiver to the transmitter is in the form of cells or packets of digital data, and wherein each set point is transmitted into the header of the cell or packet.

21. A method according to claim 1, wherein the information transmitted from the transmitter (40) to the receiver (44) being digital information transmitted by cells or packets, the characteristic of the received signal is determined at each cell.

22. A method according to claim 1, wherein the traffic flow of information from the transmitter to the receiver or from the receiver to the transmitter is of the sporadic type.

23. A method according to claim 1, wherein since the transmitter (40) is also intended to receive information from the receiver (44) and since the receiver is intended to transmit information to the transmitter, the transmission power of the receiver is controlled from a set point supplied by the transmitter.

24. A receiver design to implement the telecommunications method according to claim one, wherein, since this receiver (44), also transmits signals to the transmitter (40), it has also a means (58') to generate set points, said means (58') comprising :

- memory means (70) to store set points already generated and transmitted to the transmitter but not yet received and taken into account by said transmitter because of propagation delays;
- means for updating said not yet received set points
- means for comparison between a characteristic ($\hat{\gamma}$) of said received signal and a reference characteristic (γ_{ref}) ;

said receiver further comprising memory means (70) for storing values representing the transmission power of said received signal, wherein said stored representative values are updated each time signals are sent from the receiver to the transmitter.

25. A receiver according to claim 11, wherein said receiver further comprises a circular memory (70) with a capacity of t', where t' is the sum of the transmission delay t_p from the receiver to the transmitter, the processing time t_e calculated in the transmitter and the transmission delay time t_p from the transmitter to the receiver.

26. Application of the method according to claim 1 to a satellite-based telecommunications system in which a control station (20) and a plurality of terminals (16, 18) are provided, the terminals and control station communicating via the satellite.

IN THE ABSTRACT:

Please delete the present Abstract of the Disclosure and replace it with the following new Abstract of the Disclosure.

Abstract

The present invention relates to a telecommunications method in which a transmitter (40) transmits information to a receiver (44) having a power rating which is varied by a set point delivered by this receiver. The purpose of the set point is to maintain the power of the transmitter in such a way that a characteristic ($\hat{\gamma}$) of the received signal is constantly equal to a reference characteristic (γ_{ref}). The method is characterised in that as a delay appears (50, 48) occurring in the transmission of signals between the transmitter and the receiver, the set point is generated whenever information is received from a signal representing the transmission power of the received signal. This process provides a stable servo control despite the delays. When the characteristic features a smoothed signal to noise ratio, the method minimizes the oscillations of the characteristic measured during sudden changes in the transmission gain.

REMARKS

Entry and consideration of this Amendment is respectfully requested.

Respectfully submitted,

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Date: June 26, 2001

PRELIMINARY AMENDMENT
Attorney Docket Q64916

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

Section headings were added on pages 1,3 and 8.

IN THE CLAIMS:

Claims 1-13 were cancelled, and new claims 14-26 were added.

IN THE ABSTRACT OF DISCLOSURE:

The abstract is changed as follows:

Abstract

~~**METHOD FOR CONTROLLING A TRANSMITTER POWER BY MEANS OF RECEIVED SIGNALS**~~

The present invention relates to a telecommunications method in which a transmitter (40) transmits information to a receiver (44) having a power rating which is varied by a set point delivered by this receiver. The purpose of the set point is to maintain the power of the transmitter in such a way that a characteristic ($\hat{\gamma}$) of the received signal is constantly equal to a reference characteristic (γ_{ref}). The method is characterised in that as a delay appears (50, 48) occurring in the transmission of signals between the transmitter and the receiver, the set point is generated whenever information is received from a signal representing the transmission power of the received signal. This process provides a stable servo control despite the delays. When the characteristic features a smoothed signal to noise ratio, the method minimizes the oscillations of the characteristic measured during sudden changes in the transmission gain.

~~Figure to be published: Figure 4~~.

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3/PRTS

METHOD FOR CONTROLLING A TRANSMITTER POWER BY MEANS OF RECEIVED SIGNALS

The present invention relates to a method for controlling a transmitter power so that the signal received by a receiver has a substantially constant quality.

The invention relates generally to a telecommunications system in which the transmitter to receiver signal propagation channel has a variable gain.

It relates in particular, but not exclusively, to a telecommunications system such a satellite-based telecommunications system, in which the propagation of signals between the transmitter and the receiver may vary, for example due to a variation in the weather.

In such a system, the transmission channel gain variations are mainly caused by rain, scintillation and masking; such variations induce a sharp attenuation of the received signal compared with transmission under favourable conditions. Scintillation results from multiple paths of signals which cause additive and substractive combinaisons. Masking occurs when an antenna tracks a moving source such as a satellite and when obstacles are located on the path of the transmitted signal.

Moreover, the noise of the signal received may vary either owing to the variation of the propagation conditions or due to the fact that the noise source (whether it comes from the transmitter or from an outer interference) is variable.

A telecommunications system must ensure a minimum quality of service. For example, in the transmission of digital signals, this condition requires that the bit error rate is always less than a required rate. To meet this requirement, the signal to noise ratio of the received signal must at all times be greater than a pre-determined value.

To solve this problem, the most common solution is to assign the transmission power a sufficient value so that, regardless of the connection between the transmitter and the receiver, the signal to noise ratio obtained is always at least equal to a minimum value. However, this solution is not generally satisfactory since it entails supplying an excessive power to the transmitter, which may lead to limiting the transmission capacity of a system of which the transmitter forms a part. Indeed, when transmission occurs via a satellite which relays transmissions from several transmitters, the available power in the satellite, is limited and a high power supplied to a transmitter reduces the power available for the other. In other terms, the number

of transmitters which may be relayed by the satellite is therefore reduced. The transmission power is therefore excessive.

Another solution to the problem of variations in the transmitter power or variations in noise levels is regulation. The transmitter power is controlled by the receiver. For this purpose, the signal to noise ratio of the received signal is determined; this ratio is compared with a reference value, then, from the result of the comparaison, a set point is generated from the receiver to the transmitter. The purpose of said set point is to correct the power of the transmitter so that the transmitted signal supplies the receiver, after propagation in the transmission channel, with a signal whose signal to noise ratio is equal to the reference signal.

To compare, in the receiver, the signal to noise ratio to the reference, in general, before comparaison, a low pass filtering type smoothing of the measurement of the signal to noise ratio is performed in order to limit the noise from the transmission channel.

The implementation of such regulation raises problems that are difficult to solve in the event of a substantial delay in the transmission and/or processing of signals from the transmitter to the receiver and from the receiver to the transmitter. In fact, the set point received by the transmitter is intended to correct a situation which may have shifted between the transmission of the set point by the receiver and its reception by the transmitter and this situation may further evolve between the transmission of a data signal (applying the set power value) by the transmitter and its reception by the receiver. This lag between the moment of requested correction and the moment it is received by the receiver makes it impossible to regulate the power when the transmission channel gain - i.e. the propagation conditions in the present example - varies substantially during the transmission time.

This offset problem is exacerbated in the case of a telecommunications system with sporadic traffic (i.e. with a variable throughput) and/or in the case where the set points are transmitted from the receiver to the transmitter, only with actual information to transmit.

We disclose herein an example of an asynchronous transmission system such as an ATM ("Asynchronous Transfer Mode") system in which the receiver is a transmitter which sends data to the transmitter which then performs as a receiver. In this case, the set points are only transmitted with data packets or cells (of information

or signalling) transmitted from the receiver to the transmitter. Since the traffic is sporadic, the time that has elapsed between, on the one hand, the application of set power value to the transmitter, and, on the other, the event generating this set point in the receiver, is variable and may reach high values. Moreover, the sporadic nature of the traffic between the transmitter and the receiver entails a variable time between the moment of transmission and reception in the receiver.

In particular, in a "multimedia" type transmission system, the data traffic presents highly variable throughputs. For example, the transmission of E-mail requires a much smaller throughput than the transmission of video data.

The invention relates to a method for controlling the power of a transmitter and offers very simple solutions to the problems above mentioned.

The method according to the invention is characterised in that, whenever the receiver receives information from the transmitter, it determines a set power rating that the transmitter is required to provide according to, on the one hand, the comparison between a characteristic of the received signal with a reference, and on the other hand, the power at which the received information has been transmitted and, finally, on the other hand on the set points previously transmitted but not recorded in the information received owing to transmission delays.

The transmitter power is known by the receiver since the latter determines it via the set point values.

Once the set transmitted power value is registered by the transmitter, the stipulated power will take into account the previous received set points. The servo control may therefore operate with zero instability.

The difficulty that may result from the sporadic nature of the traffic from the receiver to the transmitter is solved in that the time of transmission of the set points is known in the receiver; the latter may take this into account to generate the subsequent set point.

The sporadic nature of the traffic from the transmitter to the receiver also has no adverse effect since the power of the transmitter is determined by the receiver; the latter knows at all times the transmission power of the signal it receives.

This method therefore overcomes instability or malfunctions which could result from transmission and processing delays.

In one embodiment, the signal representing the power of the transmitter is stored for a time t' equal to the sum of the propagation time t_p from the receiver to the transmitter, the time t_e taken to process or acknowledge the set point by the transmitter, and the propagation time t_p from the transmitter to the receiver. This time t' is known and is generally constant. The signal representing the power rating is then updated each time the set point is transmitted from the receiver to the transmitter. If the previously generated set point has not been transmitted to the transmitter whereas new information is received by the receiver, the new set point, generated from the new information received, replaces the set point which has not been transmitted.

In a preferred embodiment, the characteristic of the received signal is determined as follows: the instantaneous signal to noise ratio of this received signal is measured, the latter signal to noise ratio is divided by the transmission power of the received signal, the result of the division is smoothed (par example, by applying a low pass filter) and this smoothed division signal is multiplied by the transmission power of the received signal.

The effect of this smoothing is to intrinsically reduce the noise of a signal. Indeed, it makes it possible to substantially reduce the noise spread across the entire spectrum, the filtering only retaining the low part of the energy spectrum.

The smoothing performed on the division of the signal to noise ratio by said transmission power of the received signal makes it possible to substantially improve the quality of regulation. Indeed, the instantaneous signal to noise ratio numerator which is measured is the product of the signal issued by the attenuation (or the gain) of the transmission channel (micro-wave propagation, in the example) and if the smoothing is performed on this product, it would cause power variations to be integrated, which would cause oscillations of this smoothed signal to noise ratio during sudden changes of the transmission channel gain. Such oscillations of the measured signal would then supply inadequate values of the signal to noise ratio measured versus its real value, inducing an excessive set point value.

Consequently, when the signal to noise ratio of the received signal is divided by the transmission power, these oscillations are largely overcome, which improve the

precision of the measurement of the characteristic of the received signal and hence confers a not excessive value on the transmission power.

This facility may be used independently from the facility involving generating the set point from previously generated and stored set points.

In other words, the invention consists in using the transmission power of the received signal to generate the power set point of the transmitter. The signal representing the transmission power of the received signal may be used with the previously generated set points to determine the new set point; this signal, which represents the transmission power of the received signal, may, independently or in combination, be used to limit said oscillations of the measured signal to noise ratio. In particular, to generate the set point, it is not always essential to use previously generated set points; this applies in particular when for example, the propagation time is fairly low or when the set points are issued from the receiver to the transmitter at a fairly low frequency, or when each cell contains information on the power with which it has been issued.

In a telecommunications system for which information is transmitted from the receiver to the transmitter, since the set points are transmitted with this information, it is preferable to provide an analog system for controlling the transmission power from the receiver to the transmitter. In this case, the transmission power of the received will be controlled at the transmitter. In other words, in this situation, the receiver and the transmitter each perform the dual function of transmission and reception.

The invention provides for a telecommunications method which a transmitter transmits information to a receiver with a power that varies according to a set point supplied by the receiver, this set point being established by a comparison between a characteristic of the received signal and a reference characteristic, the purpose of the set point being to maintain the power of the transmitter at a level so that the characteristic of the received signal is constantly equal to or similar to the reference characteristic. The method is characterised in that, as a delay is provided in the transmission of the signals between the transmitter and the receiver, the set point is generated, in the receiver, whenever information is received, from, on the one hand, said comparison between the characteristic of the received signal and the reference characteristic, and, on the other hand, from a signal representing the transmission power of the received signal.

According to an embodiment, the set point is generated from the previously generated set points and transmitted to the transmitter, although the latter has been unable to register them owing to transmission delays.

According to an embodiment, since the characteristic is a smoothed signal to noise ratio in the receiver, the instantaneous signal to noise ratio of the received signal is determined, it is divided by a signal representing the transmission power of the received signal, this ratio is smoothed and the smoothed ratio is multiplied by the signal representing the transmission power of the received signal, the result of this multiplication being the characteristic which is compared to the reference.

According to an embodiment, the update at time t, in the receiver, of the signal representing the transmission power of the received signal occurs after a time t' has elapsed following transmission of a set point from the receiver to the transmitter, this time t' being equal to the time of the transmission delay t_p from the receiver to the transmitter, of the processing time t_e, or acknowledgement of the set point in the transmitter and the transmission delay time t_p from the transmitter to the receiver; this update consists in multiplying the previously stored power by the set point transmitted at time t.

According to an embodiment, the set point C(t) is generated from the following formula:

$$C(t) = \frac{\gamma_{ref}}{\hat{\gamma}(t)} \quad \frac{T_x(t)}{T_x(t + t')}$$

wherein γ_{ref} is the value of the reference characteristic, $\hat{\gamma}(t)$ the value of the characteristic measured at time t in the receiver, and $T_x(t)$ and $T_x(t+t')$ signals representing the transmission power of the signal received at times t and t+t' respectively.

According to an embodiment, the set point C(t) is generated from the following formula:

$$C(t) = \frac{\gamma_{ref}}{\hat{\gamma}(t)} \quad \frac{1}{\Pi C}.$$

Wherein γ_{ref} is the value of the reference characteristic, $\hat{\gamma}(t)$ the value of the characteristic measured at time t in the receiver, and ΠC the set point or product of the set points previously transmitted but not yet registered by the transmitter.

According to an embodiment, the set point transmitted by the receiver to the transmitter is transmitted simultaneously with information or signalling data.

According to an embodiment, the data transmitted from the receiver to the transmitter is in the form of digital data in cells or packets, each set point being transmitted at the top of the cell or packet.

According to an embodiment, the information is transmitted from the transmitter to the receiver being digital data transmitted by cells or packets, the characteristic of the received signal is determined at each cell.

According to an embodiment, the flow of information from the transmitter to the receiver or from the receiver to the transmitter is of the sporadic type.

According to an embodiment, since the purpose of the transmitter is also to receive information from the receiver and since the purpose of the receiver is to transmit information to the transmitter, the transmission power control of the receiver is performed from a set point supplied by the transmitter.

In addition, the present invention provides for a receiver to implement the telecommunications method of the invention. As this receiver also transmits signals to the transmitter, it includes means to generate set points and memory means to store signals representing the transmission power of the received signal, the value of the signal representing the transmission power of the stored and received signal being updated whenever signals are transmitted from the receiver to the transmitter.

According to an embodiment, the receiver includes a circular memory with a capacity t', wherein t' is the sum of the transmission delay t_p from the receiver to the transmitter, the processing time t_e registered in the transmitter and the transmission delay time t_p from the transmitter to the receiver.

Finally, the present invention provides for an application of the telecommunications method according, pursuant to the invention, to a satellite-based telecommunications system, in which is provided comprising a control station and a plurality of terminals, the terminal and control station communicating via the satellite.

Other features and advantages of the invention will become more apparent in light of the description of certain embodiments there of with reference to the accompanying drawings, in which:

figure 1 is a diagram showing a satellite-based telecommunication system by satellite,

figure 2 is a diagram showing known devices regulating the transmission power from a receiver,

figure 3 is a diagram explaining the defects of the system of figure 2,

figure is a diagram showing a control system according to the invention, and

figures 5 and 6 are diagrams explaining some operating features of the system illustrated in figure 4.

The example that will be described in relation to the figures pertains to a telecommunications system in which the surface of the terrestrial globe is divided into zones 10 (figure 1) of which only one has been illustrated on the figure In each zone there is, on the one hand, a central control or connection station 20, and, on the other, terminals or subscriber stations 16, 18, etc.

Terminals 16, 18, etc. communicate via a low or medium orbit satellite 14. In the example, the altitude of the satellite is about 1,500 km. This satellite 14 moves through an orbit 12 in which other satellites are located. To cover the terrestrial globe or a large part of the latter, several orbits 12 are provided.

As soon as satellite 14 looses slight of zone 10, the subsequent satellite (not shown), par example on the same orbit 12, takes over the communication.

The control and connection station 20 controls communications between terminals 16, 18, etc. In particular, it assigns frequency, power and code resources for each terminal. For this purpose, each station 20 communicates with each terminal, also via satellite 14.

The communications between terminals are performed via station 20. In other words, when terminal 16 communicates with terminal 18, terminal 16 sends data to station 20 via the satellite and station 20 re-transmits this data to terminal 18, also via the satellite.

Station 20 is connected to a terrestrial network 22, of the ATM type in the example. This station 20 is this connected via a ATM switch 34 to a wide band network 36, a narrow band network 38, and to servers 28. The narrow band network

38 enables the connection of users 30 and servers 24. Moreover, the large band network 36 enables the connection of users 32 and servers 26.

Such a telecommunications system of the ATM type enables a high throughput of data with a high capacity and short delay due to transmission.

In an asynchronous network, especially of the ATM type, the data is in digital form and organised in packets or cells including, for the ATM standard, 384 bits (or symbols) of data and 40 bits (or symbols) of header.

The problem addressed by the invention is to assign to each communication from the control station 20 to a terminal 16, 18 and from a terminal 16, 18 to the control station, a power resource just necessary so that the signal to noise ratio meets the specifications. Consequently, the communications will have the required service quality guaranteeing a bit error rate less than a pre-determined limit without excessive power consumption. Indeed, the power issued must be just the amount required since the power available in the satellite is limited and if a communication requires more power, the excess power is deducted from the power attributed to the other communications.

Moreover, since the terminals are wide distribution devices whose price must be as low as possible, they should preferably have a low power.

To control the transmission power, the signal to noise ratio is determined on reception and the transmission power is regulated so that the signal to noise ratio is equal to a reference value.

In the case of a satellite-based transmission system, the power received by the receivers may vary to a large extent, in particular owing to variations in propagation conditions due to random changes in the weather. In particular, the propagation deteriorates substantially when it rains as opposed to clear weather. The propagation also deteriorates as a result of scintillation and masking.

Propagation may also introduce noise and the noise source may feature variable characteristics. Besides thermal noise, the causes of noise may be interference due to the use of the same transmission frequencies for adjacent zones or jamming by other transmission systems.

The slaving of the transmission power to the signal to noise ratio at reception raises a difficult problem to solve in the case of the satellite-based transmission system owing to the propagation times of the set point transmitted by the receiver to

the transmitter and the time taken for transmission of signals from the transmitter to the receiver.

In the example, the delay due to signal propagation from a terminal to the control station or from the control station to a terminal is about 25 ms. This time frame is maintained constant by means of buffers. The actual propagation time varies constantly owing to the displacement of the satellite with respect to the zone, which causes a variation in the propagation distance between a terminal and the control station. However, in order to facilitate system management, the delay is maintained at a constant level by means of the above-mentioned buffers.

Moreover, since the signal to noise ratio is measured on received cells, the measurement frequency depends on the traffic flow which intrinsically varies within a multimedia communication system of the type described. Par example, the transmission frequency of the cells is lower in the case of E-mail than in the case of image or programme transmissions.

Moreover, it is preferable that the power set point transmission from the receiver to the done be done at the same time as the transmission of a cell since, as this set point only requires a small number of bits, it is preferable not to use a full cell only for transmission of the set point. It is therefore necessary to wait until (data or signalling) information has to be transmitted from the receiver to the transmitter to transmit this set pint. The sporadic nature of the traffic further increases the regulation difficulty since it entails non-deterministic, i.e. unforeseeable delays.

Consequently, a standard servo control system, where used as it, cannot operate correctly. Such a system is represented in figure 2. This figure shows that the transmitter 40 comprises an input 42 receiving a set point from a receiver 44. The transmission time between the control output 46 of the receiver 44 and the set point input 42 of the transmitter 40 corresponds to a delay symbolised by block 48. Moreover, the transmission of cells from the transmitter 40 to the receiver 44 is performed, as in the reverse transmission, by micro-wave link via satellite. This transmission provides for a channel 50 that also causes a delay. In the receiver 44, cells are received by a receiving device 52 and the signal to noise ratio $\tilde{\gamma} = \frac{E_b}{N_0}$ is constantly calculated (stack 54) on each cell received.

To limit the noise introduced by the channel 50, smoothing is performed (block 56'), i.e. in the example, through a low pass filter, on the signal supplied by block 54. This smoothed signal to noise ratio $\hat{\gamma}$ is compared at block 58, called a "decision block", to a reference value γ_{ref} applied at its input 60. Block 58 delivers, at the output 46, the set point to the transmitter 40 so that the latter adjusts its transmission power according to the comparison between the smoothed signal to noise ratio and the reference value γ_{ref}.

The smoothing 56' introduces a constraint on the transmission power. Indeed, this smoothing causes oscillations on the measured value during sudden variations of the input signal. These oscillations, which do not reflect actual oscillations of the received signal to noise ratio, are applied at block 58 and, therefore during one oscillation, this block 58 receives values $\hat{\gamma}$ which my be less than the reference γ_{ref}, whereas the real signal to noise ratio does not fall below the reference value. Consequently, the transmission power must usually be chosen with an excess value to take these measurement oscillations into account. As mentioned below, the invention, in one of its aspects, enables these unwanted oscillations to be minimized.

Moreover, as will be described in relation to figure 3, the research conducted under the present invention reveal that the delays in the servo control loop illustrated in figure 2 prevent correct operation of this loop and this research has helped to understand the malfunction of the servo control and to propose a solution for this.

For the present project, a simplified example has been considered in which it has been assumed that the power P_e has, at the beginning of the communication, a value of 1 and channel 50 presents an attenuation which increases continuously over time, this attenuation increasing by a factor α at each time unit. In other words, at the end of a time unit, the power is attenuated by a factor α, at the end of two time units the power received is attenuated by the factor α^2 and, at the end of n time units, the power is attenuated by the factor α^n. Moreover, in this example, the propagation time from the transmitter to the receiver and from the receiver to the transmitter is one time

unit, the set point is issued by the receiver 44 one time unit after it has been received and, in analog mode, the transmission power is updated one time unit after reception of the set point by the transmitter. Finally, the value of the noise N_0 is assumed to be that of the unit.

The upper line 62 (figure 3) symbolises the variation of the power P_e of the transmitter 40 versus time, the time units being marked from 0 to 15 on the lower horizontal line 64 which symbolises the receiver.

Under line are 64 symbolised the values γ of he signal to noise ratio measured at each time unit and the last line symbolises the set points transmitted by the receiver to the transmitter.

At time 0, the transmitter transmits at power 1. At time 1, the receiver receives the power α (owing to the attenuation α by time unit, transmission from the transmitter to the receiver being symbolised by an oblique arrow from top to bottom with mention of the attenuation). In these conditions, the receiver issues an increase set point to offset the attenuation. This set point is therefore an increase request in a reverse ratio, i.e. α^{-1}. However, this set point is only registered by the transmitter at time 4 owing to the above-mentioned delays. In this conditions at time 1, the transmission power is still 1, and the powers received (here, equal to γ) at times 2, 3 and 4 are α^2, α^3 and α^4 respectively, which causes, at these moments, the transmission points α^{-2}, α^{-3} and α^{-4} respectively. At time 5, the receiver receives a power $\alpha^5.\alpha^{-1} = \alpha^4$, hence a set point α^{-4}. At this time 5, the transmission power is α^{-3}, which causes a receiving power of α^3 at time 6.

This operating mode reveals clear instability of the transmission power. At time 14, for instance, the transmission power is α^3, whereas it should be α^{-11} (considering the above-mentioned delays).

This dysfunction is due to the fact that the set points are generated each time according to the received signal without taking into account the previous set points which were not acknowledged by the transmitter owing to transmission and processing delays.

For example, figure 3 shows that the set point sent at time 6 by the receiver has a value of α^{-3}. However, this set point, which will be executed at time 9 by the

transmitter does not take into account the fact that the signal received at time 6 corresponds to the signal issued at time 5 and that at times 6, 7 and 8, the transmitter will have changed power versus time 5.

Figure 4 illustrates a servo control design to solve the above two problems i.e. to minimize oscillations of the measured parameter on the one hand, and, on the other, to exercise proper, reliable and strong servo control of the transmission power according to the measurement performed in the receiver.

In this figure 4, the elements corresponding to those of figure 3 bear the same reference numbers. The fixtures illustrated in figure 4 differs from the one illustrated in figure 2 in that, according to the invention, in receiver 44, a block 70 is provided for controlling the filtering block 56' and the set point transmission block 58'.

It is possible, by means of block 70, to determine in relative value the power at which was issued the cell on which the signal to noise ratio is instantaneously calculated at block 54.

The signal representing the power with which the cell received, measured and processed at block 54, 56' and 58' was issued, may be determined in the receiver 44 since the latter determines the power of the transmitter 40.

In order to determine the power with which the cell has been issued, account is taken of the set points previously sent by the receiver 44 to the transmitter 40.

In other words, contrary to the situation illustrated in figures 2 and 3, the set point sent by the receiver to the transmitter takes into account both the received signal and the transmission power of the cell.

Moreover, the power set point requested at a given moment takes into account the set points previously sent by the receiver but which have not yet been acknowledged by the transmitter. The invention therefore stabilises control despite the inevitable delays between the generation of the set point and its acknowledgement by the transmitter.

Block 70 (figure 4) presents an output 72 connected to the input of block 56' and delivers to the latter information denoting the value of the power T_x at which the cell to be filtered at block 56′ has been issued.

At this block 56', prior to filtering, the signal $\tilde{\gamma} = \frac{E_b}{N_0}$ delivered by block 54 is divided by the transmission power value T_x.

Given that fact that $E_b = GT_x$, the signal filtered by block 56' is the signal G/N_0, where in G is the gain (or attenuation) of the channel 50, i.e. it only corresponds to the transmission channel attenuation signal to noise ratio. This system is designed to dampen oscillations of the filtered signal during changes in the gain gradient G. In this way, the power of the transmission signal may be reduced in comparison with cases where such oscillations occur.

Finally, block 56' multiplies the signal G/N_0, again smoothed by the value T_x of the transmission power to be able to compare this signal to the reference γ_{ref} at block 58'.

Moreover, block 70 comprises an input/output 74 connected to an input/output 76 of decision block 58. The latter generates the power set points to be issued on the output 46 and supplies on the input 74 of block 70 information on when the set point is transmitted, i.e. on the time when the output 46 transmits the set point to the transmitter.

To generate the set point, block 58' registers all the set points previously issued and which are not taken into account by the received cell owing to the propagation and processing times. More specifically, the received cell which is processed at blocks 54, 56' and 58', takes into account the set points issued until time t-t' and not the set points issued between the moments t-t' and t. t is the present moment and t' the sum of the signal propagation time t_p from the receiver 44 to the transmitter 40, the signal processing time t_e in the transmitter 40 and, finally, the propagation time t_p from the transmitter 40 to the receiver 44.

The time t' has a constant value since, on the one hand, as previously mentioned, a constant value is attributed to the propagation time t_p via the buffers and, on the other hand, the processing time t_e in the transmitter 40 is also constant.

Even if no buffer is provided to impose a constant transmission time between transmission by the receiver (or the transmitter) and reception by the transmitter (or the receiver), the time t_p is known at each moment since the distances separating the transmitter and the receiver from the satellite are also known at each moment.

To determine, at moment t, the power at which a received cell has been issued, the power set point requested power (by the signal on output 46) at moment t-t' must be known.

In the current example, the signal issued on the output 46 is a multiplying factor. For example, if, at time t, the power of the transmitter is P_0, the set point will be a number C_1 so that the cell received at moment t+t' is the power P_0C_1. This example only applies if between moments t-t' and t no set point has been issue. If during this time interval other set points have been issued, for example C_2 and C_3, the set point issued will always be C_1, although in this case the transmission power of the cell received at time t+t' will be $P = P_0C_1C_2C_3$.

Consequently, the transmission power of each cell received may be known at any time provided the product of the set point issued until moment t-t' is known. It is not essential to know the transmission power of the transmitter at initialisation; only the variation of this power, i.e. the variation of the set points, needs to be known.

In the embodiment described, to limit the size of the memory of block 70, only the requested powers are kept in the memory between times t-t' and t which correspond to the transmission powers of the cells received between times t and t+t'.

In the current example, the set points are issued only when a (information or signalling) communication is established from the receiver 44 to the transmitter 40. "Communication" here denotes any type of transmission of information, which encompasses both the transmission of actual data and the transmission of signalling data such as data indicating a change of satellite, the position of the satellite or verification data.

In this case, the set point is issued at the top of one of the communication cells. Consequently, transmission of the set point is not necessarily immediate. It may happen, therefore, that a cell is received by the receiver 44, whereas the set point

corresponding to the previously analysed cell has not been issued to the transmitter 40 (since in the interim no traffic has occurred from the receiver to the transmitter). In this situation, the new set point, generated from the last cell received, replaces the previous set point.

In the light of the all the above explanation, the value of the set point C(t) formed by block 58' after the reception of each cell is:

$$(1) \qquad C(t) = \frac{\gamma_{ref}}{\hat{\gamma}(t)} \quad \frac{T_x(t)}{T_x(t + t')} = \frac{\gamma_{ref}}{\hat{\gamma}(t)} \quad \frac{1}{\Pi C}$$

In the above formula, C(t) is the set point, i.e. a multiplication factor, γ_{ref} is the reference value applied to the input 60 of block 58', $\hat{\gamma}(t)$ is the output signal of the filtering block 56' applied to an input of block 58', $T_x(t)$ is the image at time t, at block 70, of the transmitter power at time $t-t_p$ and $T_x(t+t')$ is the image at time $t+t'$ of the transmitter power at time $t+t'-t_p$. The latter image is known at moment t since it depends on the set points issued by the receiver up until this moment.

The ratio $\frac{T_x(t)}{T_x(t+t')}$ corresponds to the reverse of the product of the set points of power issued by the receiver and that have not yet been taken into account by the transmitter. Indeed, it is not necessary to take into account several times these previously generated set points. ΠC is this product in the above formula (1).

Moreover, the value T_x (image of the transmission power) is updated in the memory of block 70 whenever a set point is issued; this block 70 being informed of this transmission by the signal at its input 76. This update involves, after a time t' has elapsed after transmission of the set point, multiplying the previous value T_x by the set point issued. In other words, at time t, the set point is generated on the basis of the power of the cell issued at time $t_1 = t-t_p-t_r$ (t_r is the duration of the measurement and generation of the set point in the receiver), and this set point issued at time t will be applied by the transmitter at time $t_1+t'+t_r$ and will only be received by the receiver before time $t_1+t'+t_p+t_r=t+t'$. Under such conditions, to update the power T_x, the following procedure is followed: when a set point is transmitted a time t, at the output

46, by a cell, the stored power T_x of block 70 is updated at time t+t'. This update at time t+t' involves multiplying the stored value T_x by the set point issued at time t.

As previously mentioned, when a new set point is generated on the basis of a received cell, while the previous set point has not be issued, the new set point replaces the one that could not be sent.

An example of an operating mode is illustrated in figure 5 which is a figure similar to figure 3.

This figure, as in figure 3, considers a transmitter whose initial power has a value of 1 and a transmission channel which weakens by a coefficient α every time unit. The transmission time, one way or the other, between the transmitter and the receiver is one time unit. The processing time in the receiver is one time unit. On the other hand, with regard to figure 3, for the sake of simplification, it has been assumed that the processing time in the transmitter is slight. The upper line 100 shows the variation in the power transmitted by the transmitter over time. The lower line 102 represents the receiver. The area beneath this line shows the variations in the value $\hat{\gamma}$ over time. Also shown is the variation over time: of the set points pertaining to the power C(t), of the image T_x of the power of the transmitter 40 formed at block 70, and, finally, of the set points of power sent by the receiver 44 to the transmitter 40 but which have not yet been registered by the transmitter 40.

At a given time t,, the image T_x of the power P_e is the image of the power of a cell transmitted at time $t-t_p$ (t-1 in the current example).

In the present operating example, the transmission of cells from the transmitter to the receiver (oblique lines, from line 100 to line 102) is irregular. Consequently, between moments 0 and 2, between moments 4 and 7 and between moments 10 and 14, transmission is performed at the rate of one cell per time unit, whereas between the moments 2 and 4, two time units elapse; the same applies between moments 8 and 10. Similarly, the transmission of cells from the receiver to the transmitter (horizontal dotted lines and oblique lines from line 102 to line 100). Transmission occurs at each time unit between times 2 and 6, and between times 10

and 14. However, four time units separate the transmission of one cell between moments 6 and 10.

For figure 5, the above formula (1) has been used to determine the set points C(t) and the value T_x updated has also be used and consists in multiplying the value T_x present at time t by the set point at time t-t'. In this example, the value at time t' is two time units (twice the propagation time, assuming that the processing time t_e is zero).

For example, at time 7, the set point is:

$$C(7) = \frac{1}{\alpha^4} \quad \frac{1}{\alpha^{-2}} = \alpha^{-2}$$

In the above calculation, $\frac{1}{\alpha^{-2}}$ is the reverse of the set point still not received by the transmitter which is indicated by the last line at time 7.

The values $T_x(t)$ and $T_x(t+t')$ may also be used. Par example:

$$C(7) = \frac{1}{\alpha^4} \quad \frac{T_x(7)}{T_x(9)} = \frac{1}{\alpha^4} \quad \frac{\alpha^{-3}}{\alpha^{-5}} = \alpha^2$$

To generate the value T_x at time 7, the value present in memory 70, indicated at time 6, is considered, and this value is multiplied by the set point present at time 6-t', i.e. at time 4. At time 4, the set point was 1. The value T_x then remains α^{-3} at time 7. At times 9, 10 and 11 the value T_x is maintained constant since at times 7, 8 and 9 (i.e. at times t-t'), no set point has been issued by the receiver.

It is noteworthy that despite the sporadic nature of the traffic, the power P_e correctly follows the attenuation due to propagation (notwithstanding propagation and processing delays), despite the irregularity of the traffic. The latter also causes irregularities in the transmission power variations, although such irregularities (e.g. from time 10 to time 11) do not impact the stability of the servo control.

It is also noteworthy that the process is resistant to disturbances such as signal losses from the receiver to the transmitter, i.e. disturbances such as signals issued by the receiver 40 are not received by the transmitter 44.

Figure 6 illustrates the effect of a loss of cells from the receiver to the transmitter. This example is similar to the one represented in figure 5. The assumptions are the same.

This example shows that the cells issued by the receiver at times 6, 7, 8 and 9 have not reached the transmitter, whereas the latter should have received set points at times 7, 8, 9 and 10 respectively.

In this situation, the power P_e reaches the correct value at time 13, i.e. only two time units after the end of the interruption of the transmission from the receiver to the transmitter.

An embodiment of block 70 involves providing means for storing the image of the transmission power of the received cells and updating this power via a clock or timer which updates this value to the time which is triggered upon transmission of a set point and which updates this value to the time $t' = t_p + t_e + t_p$, the new value representing the previous one multiplied by the set point during transmission of the set point. If, at the arrival of a new cell, the previous set point has not been transmitted because no cell has been transmitted from the receiver to the transmitter, the new set point established from the last received cell replaces the previous set point.

Block 70 may use, for example, a circular buffer with a capacity of t'.

Although only the power control at the receiver has been described, it is easy to understand that there is another power control loop for which the receiver transmission power is controlled at the transmitter.

CLAIMS

1. A telecommunication method, wherein:

- a transmitter (40) transmits information to a receiver (44) with a power that varies according to a set point supplied by the receiver,
- this set point is established from a comparison between a characteristic ($\hat{\gamma}$) of the received signal and a reference characteristic (γ_{ref}),
- the purpose of the set point is to maintain the power of the transmitter at such a level that the characteristic of the received signal is constantly equal to or similar to the reference characteristic,
- since a delay occurs in the transmission of signals between the transmitter and the receiver, the set point is generated in the receiver whenever information is received, from, on the one hand, said comparison between the characteristic of the received signal and the reference characteristic and, on the other hand, from a signal representing the transmission power of the received signal

characterised in that the set point is generated from the set points previously generated and transmitted to the transmitter but which the latter could not registered owing to the transmission delays.

2. A method according to claim 1, characterised in that since the characteristic is a smoothed signal to noise ratio, in the receiver, the instantaneous signal to noise ratio ($\tilde{\gamma}$) of the received signal is determined, it is divided by a signal (T_x) representing the transmission power of the received signal, this ratio is smoothed and the smoothed ratio is multiplied by the signal (T_x) representing the transmission power of the received signal, the result ($\hat{\gamma}$) of this multiplication being the characteristic which is compared to the reference.

3. A method according to claim 1 or 2, characterised in that the update, at time t, in the receiver, of the signal (T_x) representing the transmission power of the received signal is made after a time t' has elapsed following transmission of a set point from the receiver to the transmitter, this time t' being equal to the sum of the transmission delay t_p from the receiver to the transmitter, the processing time

t_e or acknowledgement of the set point in the transmitter and the transmission delay time t_p from the transmitter to the receiver, and in that this update involves multiplying the previously stored power by the set point issued at time t.

4. A method according to any one of the previous claims, characterised in that the set point C(t) is generated from the following formula:

$$C(t) = \frac{\gamma_{ref}}{\hat{\gamma}(t)} \quad \frac{T_x(t)}{T_x(t + t')}$$

wherein γ_{ref} is the value of the reference characteristic, $\hat{\gamma}(t)$ the value of the characteristic measured at time t in the receiver, $T_x(t)$ and $T_x(t+t')$ are the signals representing the transmission power of the signal received at times t and t+t' respectively.

5. A method according to any one of claims 1 to 3, characterised in that the set point C(t) is generated from the following formula:

$$C(t) = \frac{\gamma_{ref}}{\hat{\gamma}(t)} \quad \frac{1}{\Pi C}$$

in which γ_{ref} is the reference characteristic value, $\hat{\gamma}(t)$ the value of the characteristic measured at time t in the receiver and ΠC the set point or product of the set points previously issued but not yet registered by the transmitter.

6. A method according to any one of the previous claims, characterised in that the set point transmitted by the receiver to the transmitter is transmitted simultaneously with information or signalling data.

7. A method according to claim 6, characterised in that the data transmitted from the receiver to the transmitter is in the form of cells or packets of digital data, in that each set point is transmitted into the header of the cell or packet.

8. A method according to any one of the previous claims, characterised in that the information transmitted from the transmitter (40) to the receiver (44) being digital information transmitted by cells or packets, the characteristic of the received signal is determined at each cell.

9. A method according to claim 6, 7 or 8, characterised in that the traffic flow of information from the transmitter to the receiver or from the receiver to the transmitter is of the sporadic type.

10. A method according to any one of the previous claims, characterised in that since the transmitter (40) is also intended to receive information from the receiver (44) and since the receiver is intended to transmit information to the transmitter, the transmission power of the receiver is controlled from a set point supplied by the transmitter.

11. A receiver design to implement the telecommunications method according to any one of the previous claims, characterised in that, since this receiver (44), also transmits signals to the transmitter (40), it has also a means (58') to generate set points and memory means (70) to store signals representing the transmission power of the received signal, the signal representing the transmission power of the stored and received signal being updated each time signals are sent from the receiver to the transmitter.

12. A receiver according to claim 11, characterised in that whereby it comprises a circular memory (70) with a capacity of t', wherein t' is the sum of the transmission delay t_p from the receiver to the transmitter, the processing time t_e calculated in the transmitter and the transmission delay time t_p from the transmitter to the receiver.

13. Application of the method according to any one of the claims 1 à 10 to a satellite-based telecommunications system in which a control station (20) and a plurality of terminals (16, 18) are provided, the terminals and control station communicating via the satellite.

Abstract

METHOD FOR CONTROLLING A TRANSMITTER POWER BY MEANS OF RECEIVED SIGNALS

The present invention relates to a telecommunications method in which a transmitter (40) transmits information to a receiver (44) having a power rating which is varied by a set point delivered by this receiver. The purpose of the set point is to maintain the power of the transmitter in such a way that a characteristic ($\hat{\gamma}$) of the received signal is constantly equal to a reference characteristic (γ_{ref}).

The method is characterised in that as a delay appears (50, 48) occurring in the transmission of signals between the transmitter and the receiver, the set point is generated whenever information is received from a signal representing the transmission power of the received signal.

This process provides a stable servo control despite the delays.

When the characteristic features a smoothed signal to noise ratio, the method minimizes the oscillations of the characteristic measured during sudden changes in the transmission gain.

Figure to be published: Figure 4.

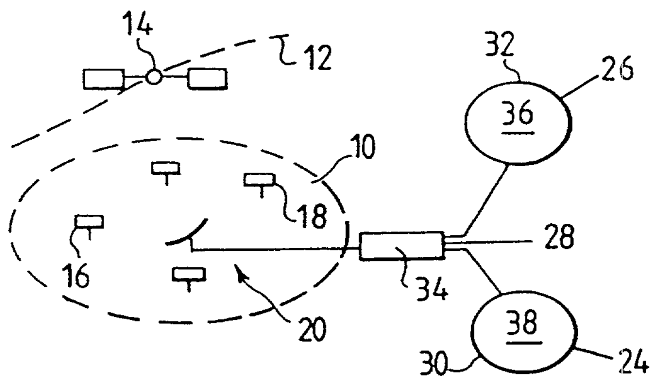


FIG.1

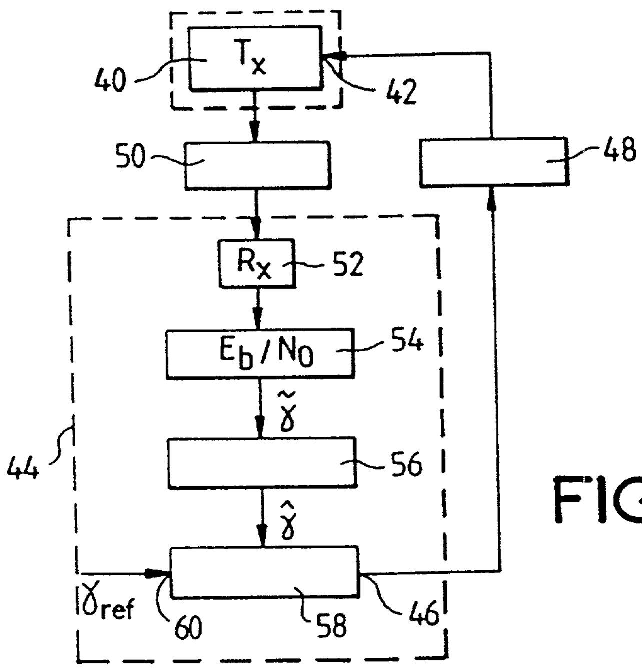
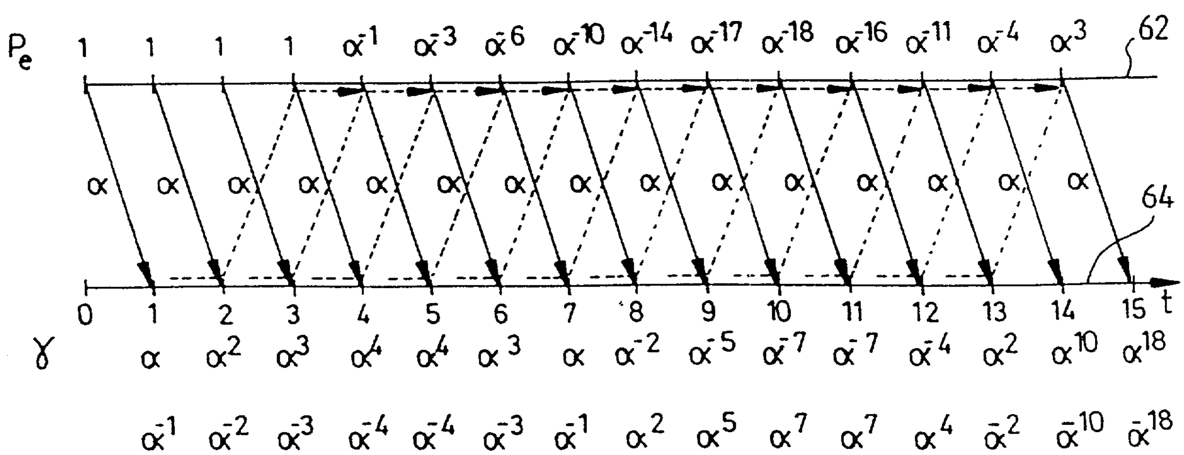


FIG.2

FIG.3



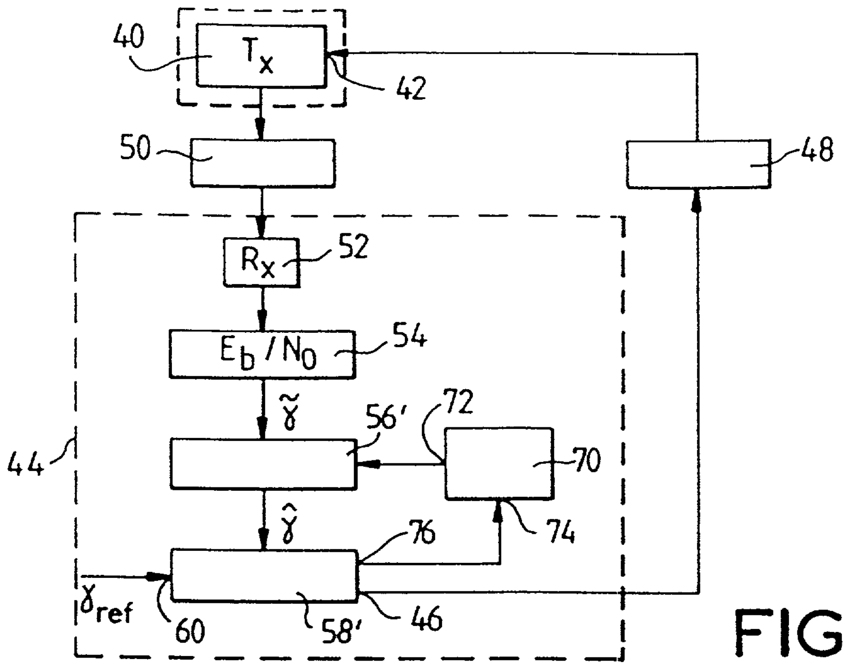
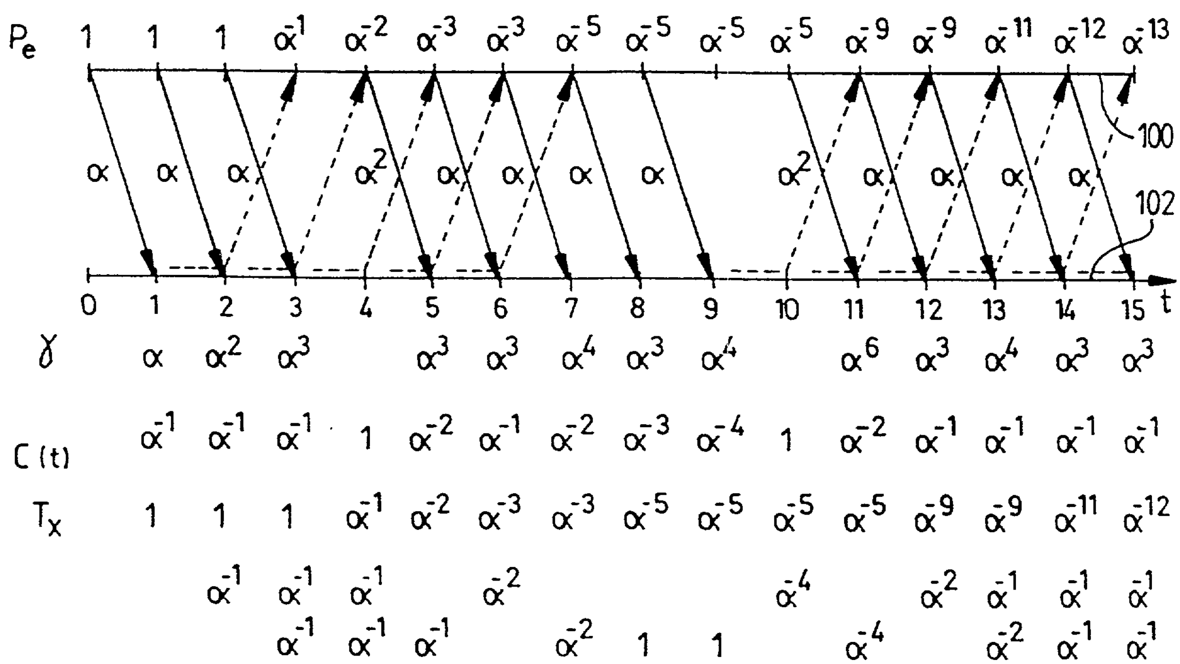

40
Tx
42
50
48
52
Rx
54
Eb / N0
56'
72
70
74
76
44
γref
60
58'
46

FIG. 4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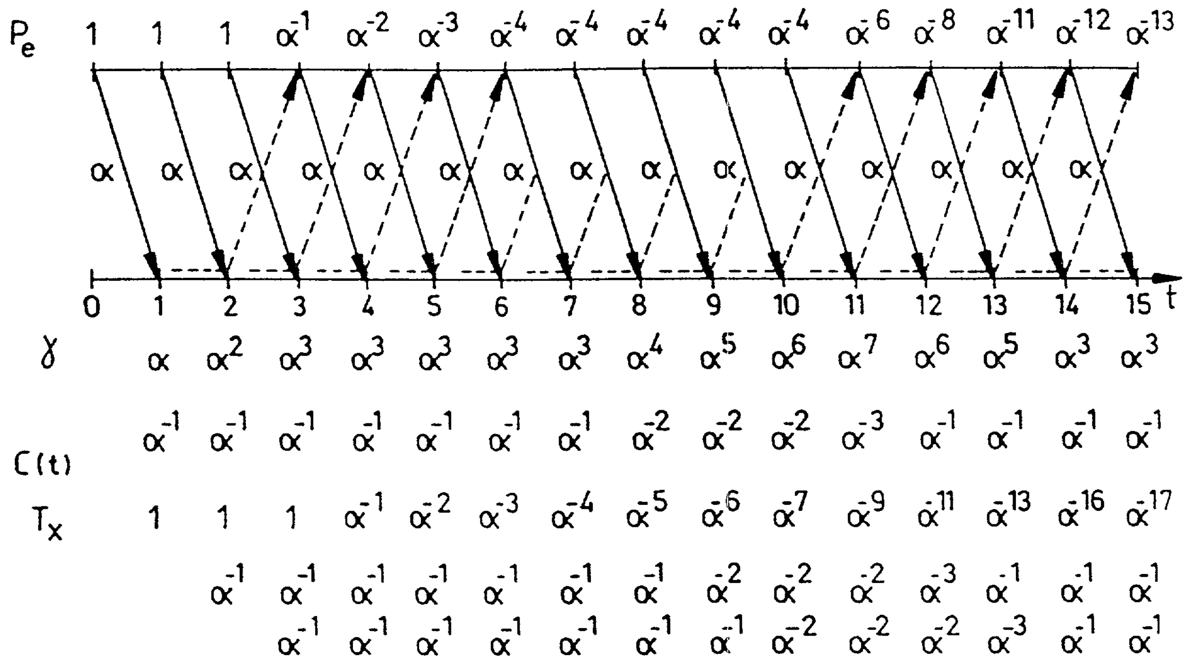
100
102
t
γ
C (t)
Tx

FIG. 5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1 1 1 α-1 α-2 α-3 α-4 α-4 α-4 α-4 α-4 α-6 α-8 α-11 α-12 α-13
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 t
γ
α α2 α3 α3 α3 α3 α3 α4 α5 α6 α7 α6 α5 α3 α3
C(t)
α-1 α-1 α-1 α-1 α-1 α-1 α-1 α-2 α-2 α-2 α-3 α-1 α-1 α-1 α-1
Tx
1 1 1 α-1 α-2 α-3 α-4 α-5 α-6 α-7 α-9 α-11 α-13 α-16 α-17

FIG.6

PTO/SB/105(8-96)
Approved for UBC through 9/30/98. OMB 0651-0032
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Déclaration and Power of Attorney for Patent Application

ENTRY INTO A NATIONAL PHASE FOR AN INTERNATIONAL APPLICATION PCT FR99/03268 filed on 23/12/1999

Déclaration et Pouvoirs pour Demande de Brevet

French Language Declaration

En tant que l'inventeur nommé ci-après, je déclare par le présent acte que :

As a below named inventor, I hereby declare that :

Mon domicile, mon adresse postale et ma nationalité sont ceux figurant ci-dessous à côté de mon nom.

My residence, post office address and citizenshiip are as stated next to my name.

Je crois être le premier inventeur original et unique (si un seul nom est mentionné ci-dessous), ou l'un des premiers co-inventeurs originaux (si plusieurs noms sont mentionnés ci-dessous) de l'objet revendiqué, pour lequel une demande de brevet a été déposée concernant l'invention intitulée

I believe I am the original, first and sole invent or (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention in the specification identified by docket n°

102105/BM/SPD

et dont la description est fournie ci-joint à moins que la case suivante n'ait été cochée :

☐ a été déposé le _______________
sous le numéro de demande des Etats-Unis ou le numéro de demande international PCT
_______________ et modifié le
_______________ (le cas échéant)

the specification of which is attached hereto unless the following box is checked :

■ was filed on
as United States Application Number or PCT International Application
and was amended on
_______________ (if applicable)

Je déclare par le présent acte avoir passé en revue et compris le contenu de la description ci-dessus, revendications comprises, telles que modifiées par toutes modification dont il aura été fait référence ci-dessus.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amenended by any amendment referred to above.

Je reconnais devoir divulguer toute information pertinente à la brevetabilité, comme défini dans le Titre 37, § 1.56 du Code fédéral des réglementations.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

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French Language Declaration

Je revendique par le présent acte avoir la priorité étrangère, en vertu du Titre 35, § 119 (a)-(d) ou § 365 (b) du Code des Etats-Unis, sur toute demande étrangère de brevet ou certificat d'inventeur ou, en vertu du Titre 35 § 365(a) du même code, sur toute la demande internationale PCT désignant au moins un pays autre que les Etats-Unis et figurant ci-dessous et, en cochant la case, j'ai aussi indiqué ci-dessous toute demande étrangère de brevet, tout certificat d'inventeur ou toute demande internationale PCT ayant à une date de dépôt précédant celle de la demande à propos de laquelle une priorité est revendiquée.

I hereby claim foreign priority under Title 35, United States Code §119(a)-(d) or § 365(b) or any foreign application(s) for patent or investor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below, and have also identified below, by checking the box, any foreign application for patent or investor's certificate, or PCT International application having a filing date before that of application on which priority is claimed.

Prior foreign application(s)
Demande(s) de brevet antérieur(s)

Priority claimed
Droit de priorité revendiqué

98 16 623 **FRANCE** **30 décembre 1998** **YES**

(Number) (Numéro) (Country) (Pays) (Day/Month/Year Filed) (Jour/Mois/Année de dépôt)

(Number) (Numéro) (Country) (Pays) (Day/Month/Year Filed) ((Jour/Mois/Année de dépôt)

Je revendique par le présent acte tout bénéfice, en vertu du Titre 35, § 199(e) du Code des Etats-Unis, de toute demande de brevet provisoire effectuée aux Etats-Unis et figurant ci-dessous.

I hereby claim the benefit under Title 35, United Sates Code, § 119(e) of any United States provisional application(s) listed below.

(Application N°.) (N° de demande) (Filing Date) (Date de dépôt)

(Application N°.) (N° de demande) (Filing Date) (Date de dépôt))

Je déclare par le présent acte tout bénéfice, en vertu du Titre 35, § 120 du Code des Etats-Unis, de toute demande de brevet effectuée aux Etats-Unis, ou en vertu du Titre 35, § 365(c) du même Code, de toute demande internationale PCT désignant les Etats-Unis et figurant ci-dessous et, dans la mesure où l'objet de chacune des revendications de cette demande de brevet n'est pas divulgué dans la demande antérieure américaine ou internationale PCT, en vertu des dispositions du premier paragraphe du Titre 35§ 112 du Code des Etats-Unis, je reconnais devoir divulguer toute information pertinente à ma brevetabilité, comme défini dans le Titre 37, §1.56 du Code fédéral des réglementations, dont j'ai pu disposer entre la date de dépôt de la demande antérieure et la date de dépôt de la demande antérieure et la date de dépôt de la demande nationale ou internationale PCT de la présente demande :

I hereby claim the benefit under Title 35, United States Code, § 120 ofany United States appplication(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code,§ 112, acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

(Application No.) (No de demande) (Filing Date) (Date de dépôt) (Status)(patented, pending abandoned) (Statut)(breveté, en cours d'examen, abandonné)

(Application No.) (No de demande) (Filing Date) (Date de dépôt)) (Status)(patented, pending abandoned) (Statut)(breveté, en cours d'examen, abandonné)

Je déclare par le présent acte que toute déclaration ci-incluse est, à ma connaissance, véridique et que toute déclaration formulée à partir de renseignements ou de suppositions est tenue pour véridique; et de plus, que toutes ces déclarations ont été formulées en sachant que toute fausse déclaration volontaire ou son équivalent est passible d'une amende ou d'une incarcération, ou des deux, en vertu de la Section 1001 du Titre 18 du Code des Etats-Unis, et que de telles déclarations volontairement fausses risquent de compromettre la validité de la demande de brevet ou du brevet délivré à partir de celle-ci.

I hereby declare all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true: and further that these statements were made with the knowledge, that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and and that such willful false statements may jeorpardize the validity of the application or any patent issued thereon.

French Language Declaration

POUVOIRS: En tant que l'inventeur cité, je désigne par la présente l'(les) avocat(s) et/ou agent(s) suivant(s) pour qu'ils poursuive(nt) la procédure de cette demande de brevet et traite(nt) toute affaire s'y rapportant avec l'Office des brevets et des marques: (mentionner le nom et le numéro d'enregistrement).

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: (list name and registration number)

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(Fournir les mêmes renseignements et la signature de tout co-inventeur supplémentaire.)

(Supply similar information and signature for third and subsequent joint inventors.)